

We Claim:

1. An electronic signal filter, comprising:

a first filter housing member extending along a longitudinal direction from a first end thereof to an opposed second end thereof;

a second filter housing member extending along said longitudinal direction from a first end thereof, which engages at least said second end of said first filter housing member, to an opposed second end thereof;

a filter cavity defined by said first and second filter housing members;

a circuit board positioned within said filter cavity, said circuit board extending from a first end thereof toward an opposed second end thereof in said longitudinal direction and having a first surface, an opposed second surface, a first edge and an opposed second edge, and a slot that opens in said first edge of said circuit board, said slot extending in a substantially lateral direction toward a terminal end thereof proximate said second edge of said circuit board; and

a ground clip for providing a ground connection between said circuit board and said first and said second filter housing members, said ground clip comprising:

a main portion having at least a first portion positioned within said slot of said circuit board,

a slot-retaining portion extending from a first end thereof proximate a first end of said main portion toward a distal end thereof in said lateral direction and being positioned within said slot of said circuit board,

at least one grounding arm extending from a first end thereof proximate said main portion toward an opposed distal end thereof, said grounding arm being in

grounding contact with at least an inner surface of said second filter housing member, and

at least one grounding leg extending from a first end thereof proximate a second end of said main portion to an opposed distal end thereof in said longitudinal direction, wherein said grounding leg extends a sufficient distance in said longitudinal direction such that at least a portion of said grounding leg is positioned in an interface between said first and said second filter housing members to achieve a secure ground contact between said circuit board, said first filter housing member, and said second filter housing member in a solderless manner.

2. The electronic signal filter of claim 1, wherein said main portion of said ground clip further comprises a second portion extending from said first surface of said circuit board in a third direction substantially perpendicular to said circuit board and a third portion extending from said second surface of said circuit board in said third direction.
3. The electronic signal filter of claim 2, wherein said second and third portions of said main portion of said ground clip are of sufficient size to provide shielding between filter components provided on at least one of said first and said second surfaces of said circuit board.
4. The electronic signal filter of claim 1, further comprising a hairpin bend between said first end of said main portion and said first end of said slot-retaining portion, such that said distal end of said slot-retaining portion extends toward said opening of said slot substantially in said lateral direction.

5. The electronic signal filter of claim 4, wherein said distal end of said slot-retaining portion comprises a first positioning member that contacts said first surface of said circuit board to prevent movement of said distal end of said slot-retaining portion in said third direction.
6. The electronic signal filter of claim 5, wherein said distal end of said slot retaining portion further comprises a second positioning member that contacts said second surface of said circuit board to prevent movement of said distal end of said slot-retaining portion in said third direction.
7. The electronic signal filter of claim 4, wherein said ground clip further comprises a notch in said hairpin bend that has a first portion dimensioned to provide a spark gap with respect to a circuit pattern provided on said circuit board.
8. The electronic signal filter of claim 7, wherein said notch extends into said first end of said main portion and said first end of said slot-retaining portion.
9. The electronic signal filter of claim 7, wherein said notch further comprises a second portion adjacent said first portion, said second portion being dimensioned to engage said circuit board and prevent movement of said grounding clip in said third direction.
10. The electronic signal filter of claim 2, wherein said at least one grounding arm comprises a first grounding arm and an opposed second grounding arm.

11. The electronic signal filter of claim 10, wherein said first grounding arm extends in said third direction from said second portion of said main portion, and said second grounding arm extends in said third direction from said third portion of said main portion, such that said first grounding arm is in grounding contact with a portion of said inner surface of said second filter housing member opposing said first surface of said circuit board, and said second grounding arm is in grounding contact with a portion of said inner surface of said second filter housing member opposing said second surface of said circuit board.

12. The electronic signal filter of claim 10, wherein a distance between said distal ends of said first and said second grounding arms is greater than an inner diameter of said second filter housing member.

13. The electronic signal filter of claim 10, wherein said first and said second grounding arms extend from said main portion in said third direction.

14. The electronic signal filter of claim 13, wherein said first and said second grounding arms are resilient such that at least a portion of said respective distal ends contacts said inner surface of said second filter housing and is deviated from said third direction toward said first end of said second filter housing in said longitudinal direction when said circuit board is inserted into said first end of said second filter housing member.

15. The electronic signal filter of claim 4, wherein said hairpin bend is sufficiently resilient such that at least said distal end of said slot-retaining portion exerts a force in said longitudinal direction away from said first portion of said main portion.

16. The electronic signal filter of claim 1, wherein said grounding leg further comprises a raised boss member opposing said first edge of said circuit board for limiting movement of said grounding leg toward said first edge of said circuit board.

17. The electronic signal filter of claim 1, wherein said second end of said first filter housing member is received within said first end of said second filter housing member.

18. The electronic signal filter of claim 17, wherein said grounding leg extends a sufficient distance in said longitudinal direction such that at least a portion of said grounding leg extends between an outer surface of said first filter housing member proximate said second end thereof and said inner surface of said second filter housing member proximate said first end thereof.

19. An electronic signal filter, comprising:

a first filter housing member extending along a longitudinal direction from a first end thereof to an opposed second end thereof;

a second filter housing member extending along said longitudinal direction from a first end thereof, which engages at least said second end of said first filter housing member, to an opposed second end thereof;

a filter cavity defined said first and second filter housing members;

a circuit board positioned within said filter cavity, said circuit board extending from a first end thereof toward an opposed second end thereof in said longitudinal direction and having a first surface, an opposed second surface, a first edge and an opposed second edge, and a slot that opens in said first edge of said circuit board, said slot extending in a

substantially lateral direction toward a terminal end thereof proximate said second edge of said circuit board; and

a ground clip for providing a ground connection between said circuit board and said first and said second filter housing members, said ground clip comprising

a main portion having a first portion positioned within said slot of said circuit board,

a slot-retaining portion extending from a first end thereof proximate a first end of said main portion toward a distal end thereof in said lateral direction and being positioned within said slot of said circuit board,

a first grounding arm extending in a third direction substantially perpendicular to said surface of said circuit board from a second portion of said main portion, and a second grounding arm extending in said third direction from a third portion of said main portion, such that said first grounding arm is in grounding contact with a portion of an inner surface of said second filter housing member opposing said first surface of said circuit board and said second grounding arm is in grounding contact with a portion of said inner surface of said second filter housing member opposing said second surface of said circuit board, wherein a distance between distal ends of said first and said second grounding arms is greater than an inner diameter of said second filter housing member, and wherein said first and said second grounding arms are resilient such that at least a portion of said respective distal ends contacts said inner surface of said second filter housing and is deviated from said third direction toward said first end of said second filter housing in said longitudinal direction when said circuit board is inserted into said first end of said second filter housing member, and

at least one grounding leg extending from a first end thereof proximate a second end of said main portion to an opposed distal end thereof in said longitudinal direction, wherein said grounding leg extends a sufficient distance in said longitudinal direction such that at least a portion of said grounding leg is positioned in an interface between said first and said second filter housing members to achieve a secure ground contact between said circuit board, said first filter housing member, and said second filter housing member in a solderless manner.

20. The electronic signal filter of claim 19, wherein said second and third portions of said main portion of said ground clip are of sufficient size to provide shielding between filter components provided on at least one of said first and said second surfaces of said circuit board.

21. The electronic signal filter of claim 19, further comprising a hairpin bend between said first end of said main portion and said first end of said slot-retaining portion, such that said distal end of said slot-retaining portion extends toward said opening of said slot substantially in said lateral direction.

22. The electronic signal filter of claim 21, wherein said distal end of said slot-retaining portion comprises a first positioning member that contacts said first surface of said circuit board to prevent movement of said distal end of said slot-retaining portion in said third direction.

23. The electronic signal filter of claim 22, wherein said distal end of said slot retaining portion further comprises a second positioning member that contacts said second surface of said circuit board to prevent movement of said distal end of said slot-retaining portion in said third direction.

24. The electronic signal filter of claim 21, wherein said ground clip further comprises a notch in said hairpin bend that has a first portion dimensioned to provide a spark gap with respect to a circuit pattern provided on said circuit board.

25. The electronic signal filter of claim 24, wherein said notch extends into said first end of said main portion and said first end of said slot-retaining portion.

26. The electronic signal filter of claim 24, wherein said notch further comprises a second portion adjacent said first portion, said second portion being dimensioned to engage said circuit board and prevent movement of said grounding clip in said third direction.

27. The electronic signal filter of claim 21, wherein said hairpin bend is sufficiently resilient such that at least said distal end of said slot-retaining portion exerts a force in said longitudinal direction away from said first portion of said main portion.

28. The electronic signal filter of claim 19, wherein said grounding leg further comprises a raised boss member opposing said first edge of said circuit board for limiting movement of said grounding leg toward said first edge of said circuit board.

29. The electronic signal filter of claim 19, wherein said second end of said first filter housing member is received within said first end of said second filter housing member.

30. The electronic signal filter of claim 29, wherein said grounding leg extends a sufficient distance in said longitudinal direction such that at least a portion of said grounding leg extends between an outer surface of said first filter housing member proximate said second end thereof and an inner surface of said second filter housing member proximate said first end thereof.

31. An electronic signal filter, comprising:

- a first filter housing member extending along a longitudinal direction from a first end thereof to an opposed second end thereof;

- a second filter housing member extending along said longitudinal direction from a first end thereof, which engages at least said second end of said first filter housing member, to an opposed second end thereof;

- a filter cavity defined by said first and second filter housing members;

- a circuit board positioned within said filter cavity, said circuit board extending from a first end thereof toward an opposed second end thereof in said longitudinal direction and having a first surface, an opposed second surface, a first edge and an opposed second edge, and a slot that opens in said first edge of said circuit board, said slot extending in a substantially lateral direction toward a terminal end thereof proximate said second edge of said circuit board; and

- a ground clip for providing a ground connection between said circuit board and said first and said second filter housing members, said ground clip comprising

a main portion having at least a first portion positioned within said slot of said circuit board,

a slot-retaining portion extending from a first end thereof proximate a first end of said main portion toward a distal end thereof in said lateral direction and being positioned within said slot of said circuit board,

a hairpin bend between said first end of said main portion and said first end of said slot-retaining portion, such that said distal end of said slot-retaining portion extends toward said opening of said slot substantially in said lateral direction,

a notch formed in said hairpin bend and having a first portion dimensioned to provide a spark gap with respect to a circuit pattern provided on said circuit board, and

at least one grounding leg extending from a first end thereof proximate a second end of said main portion to an opposed distal end thereof in said longitudinal direction, wherein said grounding leg extends a sufficient distance in said longitudinal direction such that at least a portion of said grounding leg is positioned in an interface between said first and said second filter housing members to achieve a secure ground contact between said circuit board, said first filter housing member, and said second filter housing member in a solderless manner.

32. The electronic signal filter of claim 31, wherein said main portion of said ground clip further comprises a second portion extending from said first surface of said circuit board in a third direction substantially perpendicular to said circuit board and a third portion extending from said second surface of said circuit board in said third direction.

33. The electronic signal filter of claim 32, wherein said second and third portions of said main portion of said ground clip are of sufficient size to provide shielding between filter components provided on at least one of said first and said second surfaces of said circuit board.

34. The electronic signal filter of claim 31, wherein said distal end of said slot-retaining portion comprises first and second positioning members that contact said first and second surfaces of said circuit board, respectively, to prevent movement of said distal end of said slot-retaining portion in said third direction.

35. The electronic signal filter of claim 31, wherein said notch extends into said first end of said main portion and said first end of said slot-retaining portion.

36. The electronic signal filter of claim 31, wherein said notch further comprises a second portion adjacent said first portion, said second portion being dimensioned to engage said circuit board and prevent movement of said grounding clip in said third direction.

37. The electronic signal filter of claim 31, wherein said hairpin bend is sufficiently resilient such that at least said distal end of said slot-retaining portion exerts a force in said longitudinal direction away from said first portion of said main portion.

38. The electronic signal filter of claim 31, wherein said grounding leg further comprises a raised boss member opposing said first edge of said circuit board for limiting movement of said grounding leg toward said first edge of said circuit board.

39. The electronic signal filter of claim 31, wherein said second end of said first filter housing member is received within said first end of said second filter housing member.

40. The electronic signal filter of claim 39, wherein said grounding leg extends a sufficient distance in said longitudinal direction such that at least a portion of said grounding leg extends between an outer surface of said first filter housing member proximate said second end thereof and an inner surface of said second filter housing member proximate said first end thereof.

41. An electronic signal filter, comprising:

- a first filter housing member extending along a longitudinal direction from a first end thereof to an opposed second end thereof;

- a second filter housing member extending along said longitudinal direction from a first end thereof, which engages at least said second end of said first filter housing member, to an opposed second end thereof;

- a filter cavity defined by said first and second filter housing members;

- a circuit board positioned within said filter cavity, said circuit board extending from a first end thereof toward an opposed second end thereof in said longitudinal direction and having a first surface, an opposed second surface, a first edge and an opposed second edge, and a notch having a first end that opens in said first edge of said circuit board, said notch extending a distance in a substantially lateral direction toward said second edge of said circuit board to a terminal end thereof; and

- a ground clip for providing a ground connection between said circuit board and said first and said second filter housing members, said ground clip comprising

a main portion extending from a first end to an opposed second end thereof in said lateral direction, said main portion having at least a first portion proximate said second end thereof positioned within said notch of said circuit board, said first portion of said main portion extending a distance beyond one of said first and said second surfaces of said circuit board in a third direction substantially perpendicular to said circuit board,

at least one grounding arm extending from a first end thereof proximate said main portion toward an opposed distal end thereof, said grounding arm being in grounding contact with at least an inner surface of said second filter housing member, and

at least one grounding leg extending from a first end thereof proximate a second end of said main portion to an opposed distal end thereof in said longitudinal direction;

wherein said grounding leg extends a sufficient distance in said longitudinal direction such that at least a portion of said grounding leg is in grounding contact with at least said inner surface of said second filter housing member to achieve a secure ground contact between said circuit board, said first filter housing member, and said second filter housing member in a solderless manner.

42. The electronic signal filter of claim 41, wherein a distance between said first end of said notch and said terminal end of said notch is in a range of 0.025 to 0.065 inches.

43. The electronic signal filter of claim 41, wherein said main portion of said ground clip further comprises a second portion extending from the other one of said first and said second surfaces of said circuit board said third direction.

44. The electronic signal filter of claim 43, wherein said second portion of said main portion of said ground clip is of sufficient size to provide shielding between filter components provided on said other one of said first and said second surfaces of said circuit board.

45. The electronic signal filter of claim 41, wherein said at least one grounding arm comprises a first grounding arm and a second grounding arm.

46. The electronic signal filter of claim 45, wherein said first grounding arm extends from one portion of said second portion of said main portion of said ground clip and wherein said second grounding arm extends from another portion of said second portion of said main portion of said ground clip.

47. The electronic signal filter of claim 46, wherein a distance between said first and said distal ends of each said first and said second grounding arms is greater than an inner radius of said second filter housing member.

48. The electronic signal filter of claim 46, wherein said first grounding arm extends from a lower edge portion of said second portion of said main portion of said ground clip substantially in said third direction and wherein said second grounding arm extends from

another lower edge of said second portion of said main portion of said ground clip substantially in said third direction.

49. The electronic signal filter of claim 43, wherein said main portion of said ground clip further comprises a notch formed on a portion thereof proximate said first end thereof, said notch of said main portion of said ground clip being dimensioned to provide a spark gap with respect to a circuit pattern printed on said other one of said first and said second surfaces of said circuit board.

50. The electronic signal filter of claim 45, wherein said first portion of said main portion of said ground clip further comprises a projection extending a distance from an edge portion thereof in said lateral direction beyond said terminal end of said notch, at least a portion of said projection being adapted to contact said one of said first and said second surfaces of said circuit board proximate said terminal end of said notch to provide a mechanical ground connection between said circuit board and said ground clip in a solderless manner.

51. The electronic signal filter of claim 41, wherein said circuit board further comprises an opening passing from said first surface to said second surface thereof, said opening being formed in a substantially central location laterally positioned between said first edge and said second edge of said circuit board, said opening having a central lateral axis that is substantially coaxial with a central lateral axis of said notch.

52. The electronic signal filter of claim 51, wherein said opening in said circuit board is one of an elongate slot and a substantially circular through-hole.

53. The electronic signal filter of claim 51, wherein said main portion of said ground clip further comprises a second portion extending from the other one of said first and said second surfaces of said circuit board said third direction.

54. The electronic signal filter of claim 53, wherein said second portion of said main portion of said ground clip is of sufficient size to provide shielding between filter components provided on said other one of said first and said second surfaces of said circuit board.

55. The electronic signal filter of claim 53, wherein said at least one grounding arm comprises a first grounding arm and a second grounding arm.

56. The electronic signal filter of claim 55, wherein said first and said second grounding arms respectively extend from said main portion of said ground clip in different respective locations.

57. The electronic signal filter of claim 56, further comprising a third grounding arm extending from a first end thereof proximate yet another location on said main portion of said ground clip toward a distal end thereof in said third direction.

58. The electronic signal filter of claim 56, wherein said first grounding arm extends from one portion of said second portion of said main portion of said ground clip and wherein said second grounding arm extends from another portion of said second portion of said main portion of said ground clip.

59. The electronic signal filter of claim 57, wherein said third grounding arm extends from an upper edge of said second portion of said main portion of said ground clip, passes through said opening in said circuit board and extends a distance beyond said one of said first and said second surfaces of said circuit board.

60. The electronic signal filter of claim 59, wherein said third grounding arm further comprises a hairpin bend positioned between said one of said first and said second surfaces of said circuit board and said distal end of said third grounding arm, wherein said third grounding arm is bent at said hairpin bend to extend back toward said opening of said circuit board such that said distal end of said third grounding arm is proximate said one of said first and said second surfaces of said circuit board.

61. The electronic signal filter of claim 59, wherein said circuit board further comprises a conductive pad positioned proximate said opening on at least one said one of said first and said second surfaces of said circuit board.

62. The electronic signal filter of claim 61, wherein said distal end of said third grounding arm contacts said conductive pad.

63. The electronic signal filter of claim 59, wherein said third grounding arm further comprises a substantially perpendicular bend positioned between said one of said first and said second surfaces of said circuit board and said distal end of said third grounding arm, wherein said third grounding arm is bent at said substantially perpendicular bend to extend in

said longitudinal direction such that said distal end of said third grounding arm is proximate said one of said first and said second surfaces of said circuit board.

64. The electronic signal filter of claim 63, wherein said circuit board further comprises a conductive pad positioned proximate said opening on at least one said one of said first and said second surfaces of said circuit board.

65. The electronic signal filter of claim 64, wherein said distal end of said third grounding arm contacts said conductive pad.

66. The electronic signal filter of claim 57, wherein said first grounding arm extends from an upper edge of said second portion of said main portion in said third direction and through said opening, wherein said second grounding arm extends from a lower edge of said second portion of said main portion in said third direction, and wherein said first grounding arm is in grounding contact with a portion of said inner surface of said second filter housing member opposing said one of said first and said second surface of said circuit board, and said second grounding arm is in grounding contact with a portion of said inner surface of said second filter housing member opposing said other one of said first and said second surface of said circuit board.

67. The electronic signal filter of claim 66, wherein a distance between said distal end of said first grounding arm and said distal end of said second grounding arm is greater than an inner diameter of said second filter housing member.

68. The electronic signal filter of claim 66, wherein said first and said second grounding arms are resilient such that at least a portion of said respective distal ends contacts said inner surface of said second filter housing and is deviated from said third direction toward said first end of said second filter housing in said longitudinal direction when said circuit board is inserted into said first end of said second filter housing member.

69. The electronic signal filter of claim 57, wherein said first grounding arm extends from a lateral edge of said second portion of said main portion proximate said first end of said main portion in said longitudinal direction, wherein said second grounding arm extends from a lower portion of said second portion of said main portion in said third direction, and wherein said first and said second grounding arms are in grounding contact with respective portions of said inner surface of said second filter housing member opposing said other one of said first and said second surface of said circuit board.

70. The electronic signal filter of claim 69, wherein a distance between said first end and said distal end of each said first and said second grounding arms is greater than an inner radius of said second filter housing member.

71. The electronic signal filter of claim 56, wherein said circuit board further comprises another notch having a first end that opens in said second edge of said circuit board, said another notch extending a distance in said lateral direction toward a terminal end thereof, said another notch substantially opposing said notch in said lateral direction.

72. The electronic signal filter of claim 71, wherein said main portion of said ground clip further comprises a third portion proximate said first end thereof, said third portion being positioned within said another notch of said circuit board and extending a distance beyond said one of said first and said second surfaces of said circuit board in said third direction.

73. The electronic signal filter of claim 72, wherein said first grounding arm extends from said third portion of said main portion of said ground clip in said longitudinal direction, wherein said second grounding arm extends from a lower edge of said second portion of said main portion in said third direction, and wherein said first and said second grounding arms are in grounding contact with respective portions of said inner surface of said second filter housing member opposing said other one of said first and said second surface of said circuit board.

74. The electronic signal filter of claim 73, wherein a distance between said first and said distal ends of each said first and said second grounding arms is greater than an inner radius of said second filter housing member.

75. The electronic signal filter of claim 41, wherein said grounding leg further comprises a raised boss member opposing said first edge of said circuit board for limiting movement of said grounding leg toward said first edge of said circuit board.

76. The electronic signal filter of claim 41, wherein said second end of said first filter housing member is received within said first end of said second filter housing member.

77. The electronic signal filter of claim 76, wherein said grounding leg extends a sufficient distance in said longitudinal direction such that at least a portion of said grounding leg extends between an outer surface of said first filter housing member proximate said second end thereof and said inner surface of said second filter housing member proximate said first end thereof.